ELECTRIC POWER SUPPLY EQUIPMENT FOR DRIVING MOTOR

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Applicant: AQUEOUS RES KK
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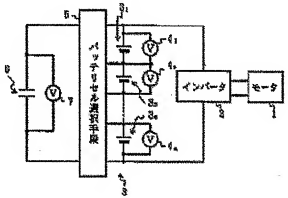
Abstract of **JP6319287**

PURPOSE:To charge a battery efficiently and each battery cell almost uniformly. CONSTITUTION:When charging a battery 3 from a capacitor 6, an arithmetic unit selects battery cells to be connected to the capacitor 6 based on the capacitor voltage detected by a capacitor voltage sensor 7 and the terminal voltage of respective, battery cells 31, 32,..., 3n detected by battery voltage sensors 41, 42,..., 4n. That is, the arithmetic unit selects in such a manner that the sum of the terminal voltages of battery cells selected becomes lower than the capacitor voltage and that priority in selection is given to battery cells with lower capacitor voltages. The arithmetic unit controls each relay of battery cell selecting means 5 so as to connect the selected battery cells to the capacitor 6.



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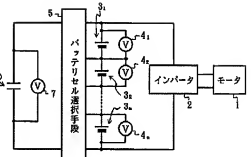
(54)【発明の名称】　モータ駆動用電源装置

(57)【要約】
【目的】　バッテリに対して効率良く充電すると共に、各バッテリセルを略均一に充電する。
【構成】　キャパシタ６からバッテリ３に充電する場合、演算装置１０は、バッテリ電圧センサ4_1、4_2、…、4_nによって検出した各バッテリセル3_1、3_2、…、3_nの端子電圧とキャパシタ電圧センサ７によって検出したキャパシタ電圧とに基づいて、キャパシタ６に接続するバッテリセルを選択する。すなわち、演算装置１０は、選択したバッテリセルの端子電圧の総和がキャパシタ電圧よりも低くなるように、かつ、キャパシタ電圧の低いバッテリセルから優先的に、バッテリセルを選択する。演算装置１０は、選択したバッテリセルをキャパシタ６に接続するように、バッテリセル選択手段５の各リレーを制御する。



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【特許請求の範囲】

【請求項1】　直列接続された複数のバッテリセルを有し、モータ駆動回路に接続された第1の電源と、

この第1の電源に並列に接続された第2の電源と、

この第2の電源から前記バッテリセルに充電する際に、前記第2の電源を複数のバッテリセルのうちの一つ以上に選択的に接続するバッテリセル選択手段とを具備することを特徴とするモータ駆動用電源装置。

【請求項2】　直列接続された複数のバッテリセルを有し、モータ駆動回路に接続された第1の電源と、

この第1の電源に並列に接続された第2の電源と、

前記各バッテリセルの端子電圧を検出する電圧検出手段と、

前記第2の電源から前記バッテリセルに充電する際に、前記電圧検出手段によって検出される各バッテリセルの端子電圧に応じて、前記第2の電源を複数のバッテリセルのうちの一つ以上に選択的に接続するバッテリセル選択手段とを具備することを特徴とするモータ駆動用電源装置。

【請求項3】　第2の電源は、燃料電池またはモータからの回生電力を蓄電する大容量コンデンサであることを特徴とする請求項1または請求項2記載のモータ駆動用電源装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、モータ駆動用電源装置に係り、詳細には、電気自動車等のモータを駆動するためのモータ駆動用電源装置に関する。

【0002】

【従来の技術】モータを駆動源とする電気自動車や、モータと従来の内燃機関とを駆動源とするハイブリット車が開発され実用化されるようになっている。このような、電気自動車やハイブリット車では、その駆動源としてのモータを駆動するための直流電源として、例えば、２４０ボルト程度のバッテリが搭載されている。そして、加速または定速走行時にバッテリから電力を取り出し、運転者の走行要求に応じた電流をインバータを介してモータに供給することで、モータを駆動している。一方、電気自動車の減速時には、モータによって駆動したエネルギを有効に回収するために、モータで発生する電力をバッテリに回生するようにしている。

【0003】ところで、従来の電源装置では、加速および減速時の走行条件によっては、バッテリに対して急速な放電および充電が行われることがある。このような急速な充放電を繰り返すと、充放電の効率が低下したり、バッテリの劣化を早めたりすることがあった。このようなバッテリの急速充電等を防止するために、例えば、特開昭４９－３７３１７号公報に示されるように、キャパシタ（コンデンサ）とバッテリを並列に接続した技術が使用されている。このキャパシタとバッテリを備えた電

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源装置では、キャパシタとバッテリが備えている次のような性質を利用している。

【0004】すなわち、キャパシタは、エネルギパワー密度（ｋｗ）が大きく、内部抵抗が小さいため、短時間の過放電、過充電には効果が大きい。しかし、エネルギ容量の大きさ（ｋｗｈ）はバッテリに比べるとかなり小さいく、バッテリの２０分の１程度である。一方、バッテリは、エネルギ容量の密度が小さく、内部抵抗が大きいため、短時間の過放電、過充電には効果や寿命が低下するが、エネルギの容量はキャパシタに比べると大きい。従って、モータからの回生エネルギは、内部抵抗の小さいキャパシタに効率的に蓄積することができる。そして、キャパシタに蓄積した電力は、モータの駆動に再利用され、また、急速充電とならないようにバッテリに回生される。

【0005】

【発明が解決しようとする課題】ところが、バッテリとキャパシタとを有する従来の電源装置では、キャパシタに回生された電力をバッテリに充電する場合、キャパシタの電圧がバッテリの電圧（２４０ボルト程度）よりも低くなると、バッテリへの充電は不可能であった。図１０はキャパシタの電圧と容量の関係を示すものである。この図は、バッテリとして１２Ｖのバッテリセルを２０個直列に接続したものを用いた場合の例であり、この図においてＶｃはキャパシタ電圧、Ｖｂはバッテリ電圧を示す。この図において、キャパシタからバッテリに充電できるのはＶｂ≦Ｖｃ つまりＶｃ ＝Ｂ～Ｃの範囲内であり、Ｖｂ＞Ｖｃ つまりＶｃ ＝０～Ｂの範囲ではキャパシタはバッテリに充電できない。従って、キャパシタからバッテリに充電できる最低範囲は約６０Ｖと狭い。なお、キャパシタからバッテリに充電できる範囲を広げるためにＶｃ の最大値を大きくすることは、キャパシタのサイズが大きくなってしまうため技術的に困難である。このように、従来は、キャパシタの容量のごく一部しか、バッテリの充電に使用することができなかった。

【0006】また、従来、キャパシタから各バッテリセルに充電する場合、各バッテリセルが均等に充電されているわけではなかった。つまり、バッテリセルの中では既に満充電に近いものもあれば、容量が少なめのものもある。しかしながら、従来は、各バッテリセルの状態を考慮することなく、キャパシタから各バッテリに一律に充電していたので、一部のバッテリが十分な充電量が得られなかったり、過充電になったりするという問題点があった。そこで本発明の第１の目的は、バッテリに対して効率良く充電できるようにしたモータ駆動用電源装置を提供することにある。また、本発明の第２の目的は、各バッテリセルを略均一に充電できるようにしたモータ駆動用電源装置を提供することにある。

【0007】

【課題を解決するための手段】請求項１記載の発明で

は、直列接続された複数のバッテリセルを有し、モータ駆動回路に接続された第１の電源と、この第１の電源に並列に接続された第２の電源と、この第２の電源からバッテリセルに充電する際に、第２の電源を複数のバッテリセルのうちの一つ以上に選択的に接続するバッテリセル選択手段とをモータ駆動用電源装置に具備させて、前記第１の目的を達成する。請求項２記載の発明では、直列接続された複数のバッテリセルを有し、モータ駆動回路に接続された第１の電源と、この第１の電源に並列に接続された第２の電源と、各バッテリセルの端子電圧を検出する電圧検出手段と、第２の電源からバッテリセルに充電する際に、電圧検出手段によって検出される各バッテリセルの端子電圧に応じて、第２の電源を複数のバッテリセルのうちの一つ以上に選択的に接続するバッテリセル選択手段とをモータ駆動用電源装置に具備させて、前記第２の目的を達成する。請求項３記載の発明では、請求項１または請求項２のモータ駆動用電源装置において、第２の電源として、燃料電池またはモータからの回生電力を蓄電する大容量コンデンサを使用することで、前記第１および第２の目的を達成する。

【０００８】

【作用】請求項１記載の発明のモータ駆動用電源装置では、第２の電源からバッテリセルに充電する際に、バッテリセル選択手段によって、第２の電源が、複数のバッテリセルのうちの一つ以上に選択的に接続される。これにより、キャパシタ等の第２の電源の電圧に応じて、第２の電源に接続するバッテリセルの数を変えることによって、第２の電源の電圧が低下してきたときでもバッテリセルへの充電が可能となる。請求項２記載の発明のモータ駆動用電源装置では、第２の電源からバッテリセルに充電する際に、バッテリセル選択手段によって、電圧検出手段によって検出される各バッテリセルの端子電圧に応じて、第２の電源が、複数のバッテリセルのうちの一つ以上に選択的に接続される。これにより、端子電圧の低いバッテリセルから選択的に充電することが可能となる。

【０００９】

【実施例】以下、本発明のモータ駆動用電源装置における一実施例を図１ないし図９を参照して詳細に説明する。図１は本実施例の電源装置を用いた電気自動車の駆動制御回路を示すブロック図である。この駆動制御回路は、電源装置からの直流をモータ１を駆動するための交流に変換するモータ駆動回路としてのインバータ２と、このインバータ２に接続された電源装置とを備えている。この電源装置は、インバータ２に接続されたバッテリ３を備えている。

【００１０】このバッテリ３は、直列に接続された複数のバッテリセル3_1、3_2、…、3_nで構成されており、各バッテリセル3_1、3_2、…、3_nの両端にはそれぞれ、各バッテリセルの端子電圧を検出するバッテリ電圧センサ4_1、4_2、…、4_n（以下、符号４で代表する。）が接続されている。またバッテリセル２つに対応して一つの電圧計を設けるように、複数のバッテリセルをひとまとめにして一つの電圧計を設けるようにして、そのスタックごとに充電を行ってもよい。また、電源装置は、バッテリ３に接続されたバッテリセル選択手段５と、このバッテリセル選択手段５に接続された大容量のキャパシタ６と、このキャパシタ６の両端に接続されたキャパシタ電圧センサ７を備えている。ここで、モータ１は例えばＤＣブラシレスモータであり、インバータ２は例えばトランジスタとダイオードを用いたブリッジ回路と平滑コンデンサとを有し、電源装置からの直流を三相交流に変換するものである。

【００１１】バッテリ３としては、鉛酸蓄電池、ニッケルカドミウム電池、ナトリウム硫黄電池、リチウム２次電池、水素２次電池、レドックス型電池等の各種２次電池が使用される。このバッテリ３は、複数台の２次電池を直列に、又は直並列に接続することによって、例えば２４０［Ｖ］の電圧となるように構成されている。

【００１２】一方、キャパシタ６としては、例えば、分極性電極と電解質界面で形成される電気二重層を利用した電気二重層コンデンサが使用される。（特開平４－１６７５１０号公報、特開平４－２８８３５１号公報参照。）この電気二重層コンデンサは、単位体積当たりの容量が大きく、更に、低抵抗で出力密度が大きいコンデンサであり、その容量は、その占有する体積とのバランスを考慮して決定し、本実施例では、例えば９Ｆ以上の大容量のコンデンサが使用される。この電気二重層コンデンサは以下のようにして製造される。多孔質活性炭と塩化ルテニウムの混合溶液中に過酸化水素を滴下して酸化ルテニウムの担持された多孔質活性炭を得る。該活性炭を結着剤とともに集電板の機能をする支持板に圧着して分極性電極を成形する。この分極性電極を一定の間隔に対向させた真ん中に分離膜を配置して、両端をガスケットで封じ、生じた空間内に電解液を充填して大容量の電気二重層コンデンサを構成する。電気二重層コンデンサは、インバータ２から回生される回生電力の電圧に耐え得るように、複数段積層されている。

【００１３】図２は図１の駆動制御回路の各部を制御する制御系の構成を示すブロック図である。本実施例の電源装置は、例えばマイクロコンピュータ等からなる演算装置１０を備えている。この演算装置１０には、バッテリ電圧センサ４、キャパシタ電圧センサ７の各出力が入力されると共に、モータ指令値等が入力されるようになっている。ここで、モータ指令値は、アクセルセンサ、ブレーキセンサ等による運転者の走行要求に対応してモータの出力を決定するための指令値である。また、演算装置１０は、インバータ２およびバッテリセル選択手段５を制御するようになっている。

【００１４】図３はバッテリセル選択手段５の構成例を

示す回路図である。なお、この図はバッテリセルの数が４つの場合について示している。このバッテリセル選択手段５は、８つのリレーＲＹ１～ＲＹ８を備えている。リレーのかわりにトランジスタスイッチを用いてもよい。リレーＲＹ１～ＲＹ４の各一端はキャパシタ６の正端子に接続されている。リレーＲＹ１の他端はバッテリセル3_1の正端子に接続され、リレーＲＹ２の他端はバッテリセル3_1とバッテリセル3_2との接続点に接続され、リレーＲＹ３の他端はバッテリセル3_2とバッテリセル3_3との接続点に接続され、リレーＲＹ４の他端はバッテリセル3_3とバッテリセル3_4との接続点に接続されている。また、リレーＲＹ８の一端はキャパシタ６の負端子に接続され、他端はバッテリセル3_4の負端子に接続されている。また、リレーＲＹ５～ＲＹ７の各一端はバッテリセル3_1とリレーＲＹ８との接続点に接続され、リレーＲＹ５の他端はバッテリセル3_1とバッテリセル3_2との接続点に接続され、リレーＲＹ６の他端はバッテリセル3_2とバッテリセル3_3との接続点に接続され、リレーＲＹ７の他端はバッテリセル3_3とバッテリセル3_4との接続点に接続されている。

【００１５】次に本実施例の動作について説明する。モータ１の駆動時には、バッテリ３より必要電流がインバータ２に供給される。必要電流が大きいときにはキャパシタ６からも電流が供給される。また、回生時は、インバータ２からの回生電流が主にキャパシタ６に充電され、停止時や、必要電流が小さいときに、この充電されたキャパシタ６からバッテリ３へ充電が行われる。なお、回生電流をキャパシタ６のみに充電するように、回生電流がバッテリ３側に流れるのを遮断するスイッチを設けても良い。キャパシタ６からバッテリ３への充電は、次のようにして行われる。すなわち、キャパシタ６からバッテリ３に充電する場合、演算装置１０は、バッテリ電圧センサ４によって検出した各バッテリセルの端子電圧とキャパシタ電圧センサ７によって検出したキャパシタ電圧とに基づいて、キャパシタ６に接続するバッテリセルを選択する。具体的には、演算装置１０は、選択したバッテリセルの端子電圧の総和がキャパシタ電圧よりも低くなるように、かつ、キャパシタ電圧の低いバッテリセルから優先的に、バッテリセルを選択する。図４はバッテリセルの放電深度（ＤＯＤ）と端子電圧の関係を示すものであるが、演算装置１０は、図４において符号１２で示すような所定の放電深度に対応する端子電圧以下のバッテリセルを優先的に選択するようにしても良い。演算装置１０は、選択したバッテリセルをキャパシタ６に接続するように、バッテリセル選択手段５の各リレーを制御する。

【００１６】図５ないし図９はバッテリセル選択手段５の動作の例を示すものである。図５は全てのバッテリセル3_1～3_4に充電する場合であり、この場合はリレーＲＹ１、ＲＹ８のみをオンする。図６はバッテリセル3_1のみを充電する場合であり、この場合はリレーＲＹ１、ＲＹ５、ＲＹ８のみをオンする。図７はバッテリセル3_2のみを充電する場合であり、この場合はリレーＲＹ２、ＲＹ６、ＲＹ８のみをオンする。図８はバッテリセル3_3のみを充電する場合であり、この場合はリレーＲＹ３、ＲＹ７、ＲＹ８のみをオンする。図９はバッテリセル3_3およびバッテリセル3_4を充電する場合であり、この場合はリレーＲＹ３、ＲＹ８のみをオンする。なお、図５ないし図９に示す例以外でもバッテリセルの選択が可能なことは言うまでもない。

【００１７】このように本実施例によれば、複数のバッテリセルのうちの任意の一つ以上に対して選択的にキャパシタ６から充電できるようにしたので、キャパシタ６の電圧が低下してきたときでも、バッテリセルへの充電が可能となる。そのため、キャパシタ６からバッテリ３への充電可能な領域は、図１０において、最大０～Ｃ、最低でもＡ～Ｃの領域となる。なお、キャパシタの電圧が低下してきたときでもバッテリに充電できるようにするためにキャパシタの電圧をＤＣ－ＤＣコンバータによって変換してバッテリに印加するという手段も考えられるが、本実施例によれば、このようなＤＣ－ＤＣコンバータを用いる必要がないという効果がある。

【００１８】また、本実施例では、各バッテリセルの端子電圧を検出し、端子電圧の低いバッテリセルから選択的に充電するようにしたので、各バッテリセルを略均一に充電することができる。

【００１９】なお、本発明は上記実施例に限定されず、例えばキャパシタ６の代わりに燃料電池を設け、この燃料電池からバッテリに充電するようにしても良い。この燃料電池はエネルギ容量の大きさは格大で、密度は待小という特性がある。この燃料電池とバッテリを併用した場合、高出力時には必要電流は主にバッテリから供給され、低出力時には必要電流は主に燃料電池から供給される。

【００２０】また、上記実施例では電気自動車のモータ駆動用の電源装置について説明したが、本発明は電気自動車に限定されるものではなく、直列接続された複数のバッテリセルを有する第１の電源と、キャパシタ、燃料電池等の第２の電源とを用いてモータを駆動する装置一般に適用することができる。

【００２１】

【発明の効果】以上説明したように請求項１記載のモータ駆動用電源装置によれば、キャパシタ等の第２の電源からバッテリセルに充電する際に、第２の電源を、複数のバッテリセルのうちの一つ以上に選択的に接続できるようにしたので、第２の電源の電圧に応じて第２の電源に接続するバッテリセルの数を変えることによって、第２の電源の電圧が低下してきたときでもバッテリセルへの充電が可能となり、バッテリに対して効率良く充電することができる。また、請求項２記載のモータ駆動用電

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源装置によれば、各バッテリセルの端子電圧を検出し、この端子電圧に応じて、第2の電源を、複数のバッテリセルのうちの一つ以上に選択的に接続するようにしたので、端子電圧の低いバッテリセルから選択的に充電することが可能となる。また、各バッテリセルを略均一に充電することができる。

【図面の簡単な説明】

【図1】本発明の電源装置の一実施例を用いた電気自動車の駆動制御回路を示すブロック図である。

【図2】図1の駆動制御回路の各部を制御する制御系の構成を示すブロック図である。

【図3】図1におけるバッテリセル選択手段の構成例を示す回路図である。

【図4】一実施例におけるバッテリセルの放電深度と端子電圧の関係を示す特性図である。

【図5】図1におけるバッテリセル選択手段の動作の例を示す説明図である。

【図6】図1におけるバッテリセル選択手段の動作の例を示す説明図である。

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【図7】図1におけるバッテリセル選択手段の動作の例を示す説明図である。

【図8】図1におけるバッテリセル選択手段の動作の例を示す説明図である。

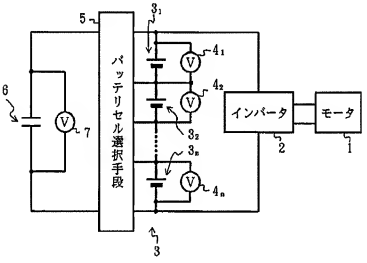
【図9】図1におけるバッテリセル選択手段の動作の例を示す説明図である。

【図10】キャパシタの電圧と容量の関係を示す特性図である。

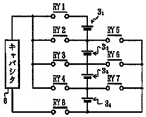
【符号の説明】

1　モータ
2　インバータ
3　バッテリ
3_1、3_2、…、3_n　バッテリセル
4　バッテリ電圧センサ
5　バッテリセル選択手段
6　キャパシタ
7　キャパシタ電圧センサ
10　演算装置

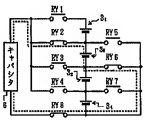
【図1】



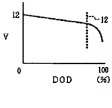
【図3】



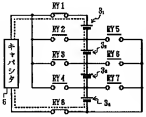
【図7】



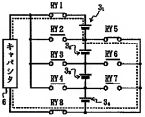
【図4】



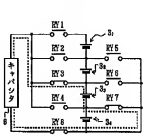
【図5】



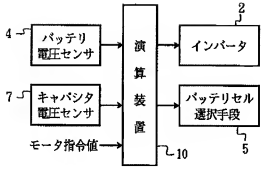
【図6】



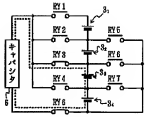
【図8】



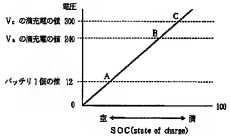
【図２】



【図９】



【図１０】



フロントページの続き

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CLAIMS

[Claim(s)]

[Claim 1]An electric power unit for motor drives characterized by comprising the following.
The 1st power supply that has two or more battery cells by which the series connection was carried out, and was connected to a motor drive circuit.
The 2nd power supply connected in parallel with this 1st power supply.
A battery cell selecting means which connects said 2nd power supply selectively of two or more battery cells or more to one when charging said battery cell from this 2nd power supply.

[Claim 2]An electric power unit for motor drives characterized by comprising the following.
The 1st power supply that has two or more battery cells by which the series connection was carried out, and was connected to a motor drive circuit.
The 2nd power supply connected in parallel with this 1st power supply.
A voltage detection means which detects terminal voltage of each of said battery cell.
A battery cell selecting means which connects said 2nd power supply selectively of two or more battery cells or more to one according to terminal voltage of each battery cell detected by said voltage detection means when charging said battery cell from said 2nd power supply.

[Claim 3]The electric power unit for motor drives according to claim 1 or 2, wherein the 2nd power supply is a large capacity capacitor which stores electricity a fuel cell or regenerative power from a motor.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to the electric power unit for motor drives, and relates to the electric power unit for motor drives for driving motors, such as an electromobile, in detail.
[0002]
[Description of the Prior Art]The electromobile which makes a motor a driving source, and the high Brit car which makes a motor and the conventional internal-combustion engine a driving source are developed and put in practical use. In such an electromobile and a high Brit car, an about 240-volt battery is carried, for example as DC power supply for driving the motor as the driving source. And electric power is taken out from a battery at the time of acceleration or a constant-speed run, and the motor is driven by supplying the current according to a driver's run demand to a motor via an inverter. In order to collect effectively the energies driven by the motor at the time of a slowdown of an electromobile, he is trying to, revive to a battery the electric power generated by a motor on the other hand.
[0003]By the way, in the conventional electric power unit, rapid discharge and charge may be performed to a battery depending on the travel condition at the time of acceleration and a slowdown. When such rapid charge and discharge were repeated, the efficiency of charge and discharge might fall and degradation of a battery might be brought forward. In order to prevent the boost charge of such a battery, etc., as shown in JP,49-37317,A, the art which connected the battery with the capacitor (capacitor) in parallel is used, for example. In the electric power unit provided with this capacitor and battery, the following character with which the capacitor and the battery are provided is used.
[0004]That is, its energy power density (kw) is large, and since internal resistance of a capacitor is small, to short-time overdischarge and a surcharge, an effect is large [a capacitor]. However, the size (kwh) of energy capacity becomes [a battery], and is about [of small ** and a battery] 1/20. On the other hand, since the density of a battery of energy capacity is low and internal resistance is large, an effect and a life fall to short-time overdischarge and a surcharge, but the capacity of energy is large compared with a capacitor. Therefore, the regenerative energy from a motor can be efficiently accumulated in a capacitor with small internal resistance. And the electric power accumulated in the capacitor is revived by the battery so that it may be reused by the drive of a motor and may not become boost charge.
[0005]
[Problem(s) to be Solved by the Invention]However, when the electric power revived by the capacitor was charged at a battery in the conventional electric power unit which has a battery and a capacitor and the voltage of the capacitor became lower than the voltage (about 240 volts) of a battery, the charge to a battery was impossible. Drawing 10 shows the voltage of a capacitor, and the relation of capacity. This figure is an example at the time of using as a battery what connected the battery cell of 12V to 20-piece series, in this figure, V_C shows capacitor voltage and V_B shows battery voltage. In this figure, within the limits of =[V_B<=V_C, i.e., V_C,] B-

C can charge a battery from a capacitor, and the capacitor cannot charge a battery in the range of $V_B > V_C$, i.e., $V_C = 0$, - B. Therefore, the minimum range which can charge a battery from a capacitor is as narrow as about 60 v. Since the size of a capacitor becomes large, it is technically difficult to enlarge the maximum of V_C, in order to extend the range which can charge a battery from a capacitor. thus, the former — the capacity of a capacitor — only the part was able to be used very much for charge of a battery.

[0006]When charging each battery cell from a capacitor conventionally, each battery cell was not necessarily charged uniformly. That is, in a battery cell, there is already a thing near a full charge, and fewer things have capacity. However, since it had charged uniformly for each battery from the capacitor, without taking the state of each battery cell into consideration conventionally, there was a problem of charge with some sufficient batteries not having been obtained, or becoming a surcharge. Then, the 1st purpose of this invention is to provide the electric power unit for motor drives it enabled it to charge efficiently to a battery. The 2nd purpose of this invention is to provide the electric power unit for motor drives which enabled it to charge each battery cell at abbreviated homogeneity.

[0007]

[Means for Solving the Problem]The 1st power supply that has two or more battery cells by which the series connection was carried out in the invention according to claim 1, and was connected to a motor drive circuit, When charging a battery cell from the 2nd power supply connected in parallel with this 1st power supply, and this 2nd power supply, an electric power unit for motor drives is made to possess a battery cell selecting means which connects the 2nd power supply selectively of two or more battery cells or more to one, and said 1st purpose is attained. The 1st power supply that has two or more battery cells by which the series connection was carried out in the invention according to claim 2, and was connected to a motor drive circuit, The 2nd power supply connected in parallel with this 1st power supply, and a voltage detection means which detects terminal voltage of each battery cell, When charging a battery cell from the 2nd power supply, according to terminal voltage of each battery cell detected by a voltage detection means, An electric power unit for motor drives is made to possess a battery cell selecting means which connects the 2nd power supply selectively of two or more battery cells or more to one, and said 2nd purpose is attained. In the invention according to claim 3, using a large capacity capacitor which stores electricity a fuel cell or regenerative power from a motor as the 2nd power supply attains said 1st and 2nd purposes in an electric power unit for motor drives of claim 1 or claim 2.

[0008]

[Function]In the electric power unit for motor drives of the invention according to claim 1, when charging a battery cell from the 2nd power supply, the 2nd power supply is connected selectively of two or more battery cells or more to one by a battery cell selecting means. Even when this changes the number of the battery cells linked to the 2nd power supply according to the voltage of the 2nd power supply of a capacitor etc., and the voltage of the 2nd power supply has fallen, the charge to a battery cell is attained. In the electric power unit for motor drives of the invention according to claim 2. When charging a battery cell from the 2nd power supply, according to the terminal voltage of each battery cell detected by a voltage detection means, the 2nd power supply is connected selectively of two or more battery cells or more to one by a battery cell selecting means. This becomes possible from a battery cell with low terminal voltage to charge selectively.

[0009]

[Example]Hereafter, one example in the electric power unit for motor drives of this invention is described in detail with reference to drawing 1 thru/or drawing 9. Drawing 1 is a block diagram showing the drive control circuit of the electromobile which used the electric power unit of this example. This drive control circuit is provided with the inverter 2 as a motor drive circuit which changes a direct current from an electric power unit into the exchange for driving the motor 1, and the electric power unit connected to this inverter 2. This electric power unit is provided with the battery 3 connected to the inverter 2.

[0010]This battery 3 comprises two or more battery cell 3_1 connected in series, 3_2, —, 3_n, Each battery cell 3_1, 3_2, —, battery voltage sensor 4_1 that detects the terminal voltage of each battery cell in the both ends of 3_n, respectively, 4_2, —, 4_n (it represents with the numerals 4 hereafter.) are connected.
As two or more battery cells are put together and one voltmeter is formed, it may charge for every stack of the, so that one voltmeter may be formed corresponding to two battery cells. The electric power unit is provided with the capacitor voltage sensor 7 connected to the both ends of the battery cell selecting means 5 connected to the battery 3, the mass capacitor 6 connected to this battery cell selecting means 5, and this capacitor 6. Here, the motor 1 is a DC brushless motor, and the inverter 2 has the bridged circuit and smoothing capacitor which used the transistor and the diode, and changes a direct current from an electric power unit into a three phase alternating current.
[0011]As the battery 3, various rechargeable batteries, such as a lead acid battery, a nickel-cadmium battery, a sodium sulfur battery, a lithium secondary battery, a hydrogen rechargeable battery, and a redox type cell, are used. This battery 3 is 240, for example by connecting two or more sets of rechargeable batteries to series parallel in series. [V] It is constituted so that it may become voltage.
[0012]On the other hand, as the capacitor 6, a polarizable electrode and the electric double layer capacitor using the electric double layer formed by an electrolyte interface are used, for example. (Refer to JP,4-167510,A and JP,4-288351,A.) This electric double layer capacitor has the large capacity per unit volume, and power density is a large capacitor in low resistance further.
The capacity is determined in consideration of balance with the volume to occupy, and the mass capacitor beyond 9F is used in this example, for example.
This electric double layer capacitor is performed as follows, and is manufactured. The porosity activated carbon which trickled hydrogen peroxide into porosity activated carbon and the mixed solution of ruthenium chloride and with which ruthenium oxide was supported is obtained. This activated carbon is stuck to the support plate which carries out the function of a collecting electrode plate with a binder by pressure, and a polarizable electrode is fabricated. A demarcation membrane is arranged in the middle which made this polarizable electrode counter a fixed interval, and a gasket stops both ends, it is filled up with an electrolysis solution in the produced space, and a mass electric double layer capacitor is constituted. Two or more steps of electric double layer capacitors are laminated so that the voltage of the regenerative power revived from the inverter 2 can be borne.
[0013]Drawing 2 is a block diagram showing the composition of the control system which controls each part of the drive control circuit of drawing 1. The electric power unit of this example is provided with the arithmetic unit 10 which consists of microcomputers etc., for example. Each output of the battery voltage sensor 4 and the capacitor voltage sensor 7 is inputted, and a motor command value etc. are inputted into this arithmetic unit 10. Here, a motor command value is a command value for opting for the output of a motor corresponding to a run demand of the driver by accelerator sensor, a brake sensor, etc. The arithmetic unit 10 controls the inverter 2 and the battery cell selecting means 5.
[0014]Drawing 3 is a circuit diagram showing the example of composition of the battery cell selecting means 5. This figure shows the case where the number of battery cells is four. This battery cell selecting means 5 is provided with eight relays RY1-RY8. A transistor switch may be used instead of a relay. One end each of the relays RY1-RY4 is connected to the positive terminal of the capacitor 6. The other end of relay RY1 is connected to the positive terminal of battery cell 3_1. The other end of relay RY2 is connected at the node of battery cell 3_1 and battery cell 3_2. The other end of relay RY3 is connected at the node of battery cell 3_2 and battery cell 3_3, and the other end of relay RY4 is connected at the node of battery cell 3_3 and battery cell 3_4. One end of relay RY8 is connected to the negative terminal of the capacitor 6,

and the other end is connected to the negative terminal of battery cell 3 $_4$. One end each of the relays RY5-RY7 is connected at the node of battery cell 3 $_4$ and relay RY8, The other end of relay RY5 is connected at the node of battery cell 3 $_1$ and battery cell 3 $_2$, The other end of relay RY6 is connected at the node of battery cell 3 $_2$ and battery cell 3 $_3$, and the other end of relay RY7 is connected at the node of battery cell 3 $_3$ and battery cell 3 $_4$.

[0015]Next, operation of this example is explained. At the time of the drive of the motor 1, required current is supplied to the inverter 2 from the battery 3. When required current is large, current is supplied also from the capacitor 6. At the time of regeneration, the regenerative current from the inverter 2 is mainly charged by the capacitor 6, and the time of a stop, and when required current is small, charge is performed from this charged capacitor 6 to the battery 3. The switch which intercepts that regenerative current flows into the battery 3 side may be formed so that regenerative current may be charged only at the capacitor 6. Charge to the battery 3 from the capacitor 6 is performed as follows. That is, when charging the battery 3 from the capacitor 6, the arithmetic unit 10 chooses the battery cell linked to the capacitor 6 based on the terminal voltage of each battery cell detected by the battery voltage sensor 4, and the capacitor voltage detected by the capacitor voltage sensor 7. Specifically, the arithmetic unit 10 chooses a battery cell from a battery cell with low capacitor voltage preferentially so that total of the terminal voltage of the selected battery cell may become lower than capacitor voltage. Although drawing 4 shows the depth of discharge (DOD) of a battery cell, and the relation of terminal voltage, it may be made for the arithmetic unit 10 to choose preferentially the battery cell below the terminal voltage corresponding to predetermined depth of discharge as shown with the numerals 12 in drawing 4. The arithmetic unit 10 controls each relay of the battery cell selecting means 5 to connect the selected battery cell to the capacitor 6.

[0016]Drawing 5 thru/or drawing 9 show the example of operation of the battery cell selecting means 5. One [drawing 5 / drawing 5 is a case where all the battery cell 3 $_1$ – 3 $_4$ are charged, and / relay RY1 and RY8] in this case. One [drawing 6 / drawing 6 is a case where only battery cell 3 $_1$ is charged, and / relay RY1, RY5, and RY8] in this case. One [drawing 7 / drawing 7 is a case where only battery cell 3 $_2$ is charged, and / relay RY2, RY6, and RY8] in this case. One [drawing 8 / drawing 8 is a case where only battery cell 3 $_3$ is charged, and / relay RY3, RY7, and RY8] in this case. One [drawing 9 / drawing 9 is a case where battery cell 3 $_3$ and battery cell 3 $_4$ are charged, and / relay RY3 and RY8] in this case. It cannot be overemphasized that selection of a battery cell is possible also except the example shown in drawing 5 thru/or drawing 9.

[0017]Thus, since it enabled it to charge from the capacitor 6 selectively or more to arbitrary one out of two or more battery cells according to this example, even when the voltage of the capacitor 6 has fallen, the charge to a battery cell is attained. Therefore, the field in which the charge to the battery 3 is possible turns into a field of A–C from the capacitor 6 also a maximum of 0–C and the minimum in drawing 10. Even when the voltage of a capacitor has fallen, in order to be able to charge a battery, a means by which change the voltage of a capacitor with a DC–DC converter, and it is impressed by a battery is also considered, but. According to this example, it is effective in not using such a DC–DC converter.

[0018]In this example, the terminal voltage of each battery cell is detected, and since it was made to charge selectively from a battery cell with low terminal voltage, each battery cell can be charged at abbreviated homogeneity.

[0019]This invention is not limited to the above–mentioned example, for example, forms a fuel cell instead of the capacitor 6, and it may be made to charge a battery from this fuel cell. The size of energy capacity is extra–large and this fuel cell has the characteristic of **** in density. When this fuel cell and battery are used together, at the time of high power, required current is mainly supplied from a battery, and required current is mainly supplied from a fuel cell at the time of low–power output.

[0020]Although the above-mentioned example explained the electric power unit for the motor drives of an electromobile, This invention is not limited to an electromobile and can be applied to the general device which drives a motor using the 1st power supply that has two or more battery cells by which the series connection was carried out, and the 2nd power supply, such as a capacitor and a fuel cell.

[0021]

[Effect of the Invention]Since it enabled it to connect the 2nd power supply selectively of two or more battery cells or more to one according to the electric power unit for motor drives according to claim 1 as explained above when charging a battery cell from the 2nd power supply of a capacitor etc., By changing the number of the battery cells which connect with the 2nd power supply according to the voltage of the 2nd power supply, even when the voltage of the 2nd power supply has fallen, the charge to a battery cell is attained, and it can charge efficiently to a battery. According to the electric power unit for motor drives according to claim 2, since the 2nd power supply was connected selectively of two or more battery cells or more to one by detecting the terminal voltage of each battery cell according to this terminal voltage, It becomes possible from a battery cell with low terminal voltage to charge selectively. Each battery cell can be charged at abbreviated homogeneity.

[Translation done.]

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TECHNICAL FIELD

[Industrial Application]This invention relates to the electric power unit for motor drives, and relates to the electric power unit for motor drives for driving motors, such as an electromobile, in detail.

[Translation done.]

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PRIOR ART

[Description of the Prior Art]The electromobile which makes a motor a driving source, and the high Brit car which makes a motor and the conventional internal-combustion engine a driving source are developed and put in practical use. In such an electromobile and a high Brit car, an about 240-volt battery is carried, for example as DC power supply for driving the motor as the driving source. And electric power is taken out from a battery at the time of acceleration or a constant-speed run, and the motor is driven by supplying the current according to a driver's run demand to a motor via an inverter. In order to collect effectively the energies driven by the motor at the time of a slowdown of an electromobile, he is trying to, revive to a battery the electric power generated by a motor on the other hand.
[0003]By the way, in the conventional electric power unit, rapid discharge and charge may be performed to a battery depending on the travel condition at the time of acceleration and a slowdown. When such rapid charge and discharge were repeated, the efficiency of charge and discharge might fall and degradation of a battery might be brought forward. In order to prevent the boost charge of such a battery, etc., as shown in JP,49-37317,A, the art which connected the battery with the capacitor (capacitor) in parallel is used, for example. In the electric power unit provided with this capacitor and battery, the following character with which the capacitor and the battery are provided is used.
[0004]That is, its energy power density (kw) is large, and since internal resistance of a capacitor is small, to short-time overdischarge and a surcharge, an effect is large [a capacitor]. However, the size (kwh) of energy capacity becomes [a battery], and is about [of small ** and a battery] 1/20. On the other hand, since the density of a battery of energy capacity is low and internal resistance is large, an effect and a life fall to short-time overdischarge and a surcharge, but the capacity of energy is large compared with a capacitor. Therefore, the regenerative energy from a motor can be efficiently accumulated in a capacitor with small internal resistance. And the electric power accumulated in the capacitor is revived by the battery so that it may be reused by the drive of a motor and may not become boost charge.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention]Since it enabled it to connect the 2nd power supply selectively of two or more battery cells or more to one according to the electric power unit for motor drives according to claim 1 as explained above when charging a battery cell from the 2nd power supply of a capacitor etc., By changing the number of the battery cells which connect with the 2nd power supply according to the voltage of the 2nd power supply, even when the voltage of the 2nd power supply has fallen, the charge to a battery cell is attained, and it can charge efficiently to a battery. According to the electric power unit for motor drives according to claim 2, since the 2nd power supply was connected selectively of two or more battery cells or more to one by detecting the terminal voltage of each battery cell according to this terminal voltage, It becomes possible from a battery cell with low terminal voltage to charge selectively. Each battery cell can be charged at abbreviated homogeneity.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]However, when the electric power revived by the capacitor was charged at a battery in the conventional electric power unit which has a battery and a capacitor and the voltage of the capacitor became lower than the voltage (about 240 volts) of a battery, the charge to a battery was impossible. Drawing 10 shows the voltage of a capacitor, and the relation of capacity. This figure is an example at the time of using as a battery what connected the battery cell of 12V to 20-piece series, in this figure, V_C shows capacitor voltage and V_B shows battery voltage. In this figure, within the limits of =[$V_B <= V_C$, i.e., V_C,] B-C can charge a battery from a capacitor, and the capacitor cannot charge a battery in the range of $V_B > V_C$, i.e., V_C=0, - B. Therefore, the minimum range which can charge a battery from a capacitor is as narrow as about 60 v. Since the size of a capacitor becomes large, it is technically difficult to enlarge the maximum of V_C, in order to extend the range which can charge a battery from a capacitor. thus, the former -- the capacity of a capacitor -- only the part was able to be used very much for charge of a battery.
[0006]When charging each battery cell from a capacitor conventionally, each battery cell was not necessarily charged uniformly. That is, in a battery cell, there is already a thing near a full charge, and fewer things have capacity. However, since it had charged uniformly for each battery from the capacitor, without taking the state of each battery cell into consideration conventionally, there was a problem of charge with some sufficient batteries not having been obtained, or becoming a surcharge. Then, the 1st purpose of this invention is to provide the electric power unit for motor drives it enabled it to charge efficiently to a battery. The 2nd purpose of this invention is to provide the electric power unit for motor drives which enabled it to charge each battery cell at abbreviated homogeneity.

[Translation done.]

MEANS

[Means for Solving the Problem]The 1st power supply that has two or more battery cells by which the series connection was carried out in the invention according to claim 1, and was connected to a motor drive circuit, When charging a battery cell from the 2nd power supply connected in parallel with this 1st power supply, and this 2nd power supply, an electric power unit for motor drives is made to possess a battery cell selecting means which connects the 2nd power supply selectively of two or more battery cells or more to one, and said 1st purpose is attained. The 1st power supply that has two or more battery cells by which the series connection was carried out in the invention according to claim 2, and was connected to a motor drive circuit, The 2nd power supply connected in parallel with this 1st power supply, and a voltage detection means which detects terminal voltage of each battery cell, When charging a battery cell from the 2nd power supply, according to terminal voltage of each battery cell detected by a voltage detection means, An electric power unit for motor drives is made to possess a battery cell selecting means which connects the 2nd power supply selectively of two or more battery cells or more to one, and said 2nd purpose is attained. In the invention according to claim 3, using a large capacity capacitor which stores electricity a fuel cell or regenerative power from a motor as the 2nd power supply attains said 1st and 2nd purposes in an electric power unit for motor drives of claim 1 or claim 2.

[Translation done.]

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OPERATION

[Function]In the electric power unit for motor drives of the invention according to claim 1, when charging a battery cell from the 2nd power supply, the 2nd power supply is connected selectively of two or more battery cells or more to one by a battery cell selecting means. Even when this changes the number of the battery cells linked to the 2nd power supply according to the voltage of the 2nd power supply of a capacitor etc., and the voltage of the 2nd power supply has fallen, the charge to a battery cell is attained. In the electric power unit for motor drives of the invention according to claim 2. When charging a battery cell from the 2nd power supply, according to the terminal voltage of each battery cell detected by a voltage detection means, the 2nd power supply is connected selectively of two or more battery cells or more to one by a battery cell selecting means. This becomes possible from a battery cell with low terminal voltage to charge selectively.

[Translation done.]

EXAMPLE

[Example]Hereafter, one example in the electric power unit for motor drives of this invention is described in detail with reference to drawing 1 thru/or drawing 9. Drawing 1 is a block diagram showing the drive control circuit of the electromobile which used the electric power unit of this example. This drive control circuit is provided with the inverter 2 as a motor drive circuit which changes a direct current from an electric power unit into the exchange for driving the motor 1, and the electric power unit connected to this inverter 2. This electric power unit is provided with the battery 3 connected to the inverter 2.

[0010]This battery 3 comprises two or more battery cell 3_1 connected in series, 3_2, —, 3_n. Each battery cell 3_1, 3_2, —, battery voltage sensor 4_1 that detects the terminal voltage of each battery cell in the both ends of 3_n, respectively, 4_2, --, 4_n (it represents with the numerals 4 hereafter.) are connected.

As two or more battery cells are put together and one voltmeter is formed, it may charge for every stack of the, so that one voltmeter may be formed corresponding to two battery cells. The electric power unit is provided with the capacitor voltage sensor 7 connected to the both ends of the battery cell selecting means 5 connected to the battery 3, the mass capacitor 6 connected to this battery cell selecting means 5, and this capacitor 6. Here, the motor 1 is a DC brushless motor, and the inverter 2 has the bridged circuit and smoothing capacitor which used the transistor and the diode, and changes a direct current from an electric power unit into a three phase alternating current.

[0011]As the battery 3, various rechargeable batteries, such as a lead acid battery, a nickel-cadmium battery, a sodium sulfur battery, a lithium secondary battery, a hydrogen rechargeable battery, and a redox type cell, are used. This battery 3 is 240, for example by connecting two or more sets of rechargeable batteries to series parallel in series. [V] It is constituted so that it may become voltage.

[0012]On the other hand, as the capacitor 6, a polarizable electrode and the electric double layer capacitor using the electric double layer formed by an electrolyte interface are used, for example. (Refer to JP,4-167510,A and JP,4-288351,A.) This electric double layer capacitor has the large capacity per unit volume, and power density is a large capacitor in low resistance further.

The capacity is determined in consideration of balance with the volume to occupy, and the mass capacitor beyond 9F is used in this example, for example.

This electric double layer capacitor is performed as follows, and is manufactured. The porosity activated carbon which trickled hydrogen peroxide into porosity activated carbon and the mixed solution of ruthenium chloride and with which ruthenium oxide was supported is obtained. This activated carbon is stuck to the support plate which carries out the function of a collecting electrode plate with a binder by pressure, and a polarizable electrode is fabricated. A demarcation membrane is arranged in the middle which made this polarizable electrode counter a fixed interval, and a gasket stops both ends, it is filled up with an electrolysis solution in the produced space, and a mass electric double layer capacitor is constituted. Two or more steps of electric double layer capacitors are laminated so that the voltage of the regenerative power

revived from the inverter 2 can be borne.

[0013]Drawing 2 is a block diagram showing the composition of the control system which controls each part of the drive control circuit of drawing 1. The electric power unit of this example is provided with the arithmetic unit 10 which consists of microcomputers etc., for example. Each output of the battery voltage sensor 4 and the capacitor voltage sensor 7 is inputted, and a motor command value etc. are inputted into this arithmetic unit 10. Here, a motor command value is a command value for opting for the output of a motor corresponding to a run demand of the driver by accelerator sensor, a brake sensor, etc. The arithmetic unit 10 controls the inverter 2 and the battery cell selecting means 5.

[0014]Drawing 3 is a circuit diagram showing the example of composition of the battery cell selecting means 5. This figure shows the case where the number of battery cells is four. This battery cell selecting means 5 is provided with eight relays RY1-RY8. A transistor switch may be used instead of a relay. One end each of the relays RY1-RY4 is connected to the positive terminal of the capacitor 6. The other end of relay RY1 is connected to the positive terminal of battery cell 3_1. The other end of relay RY2 is connected at the node of battery cell 3_1 and battery cell 3_2, The other end of relay RY3 is connected at the node of battery cell 3_2 and battery cell 3_3, and the other end of relay RY4 is connected at the node of battery cell 3_3 and battery cell 3_4. One end of relay RY8 is connected to the negative terminal of the capacitor 6, and the other end is connected to the negative terminal of battery cell 3_4. One end each of the relays RY5-RY7 is connected at the node of battery cell 3_4 and relay RY8, The other end of relay RY5 is connected at the node of battery cell 3_1 and battery cell 3_2. The other end of relay RY6 is connected at the node of battery cell 3_2 and battery cell 3_3, and the other end of relay RY7 is connected at the node of battery cell 3_3 and battery cell 3_4.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a block diagram showing the drive control circuit of the electromobile using one example of the electric power unit of this invention.
[Drawing 2]It is a block diagram showing the composition of the control system which controls each part of the drive control circuit of drawing 1.
[Drawing 3]It is a circuit diagram showing the example of composition of the battery cell selecting means in drawing 1.
[Drawing 4]It is a characteristic figure showing the depth of discharge of a battery cell and the relation of terminal voltage to one example.
[Drawing 5]It is an explanatory view showing the example of operation of the battery cell selecting means in drawing 1.
[Drawing 6]It is an explanatory view showing the example of operation of the battery cell selecting means in drawing 1.
[Drawing 7]It is an explanatory view showing the example of operation of the battery cell selecting means in drawing 1.
[Drawing 8]It is an explanatory view showing the example of operation of the battery cell selecting means in drawing 1.
[Drawing 9]It is an explanatory view showing the example of operation of the battery cell selecting means in drawing 1.
[Drawing 10]It is a characteristic figure showing the voltage of a capacitor, and the relation of capacity.
[Description of Notations]
1 Motor
2 Inverter
3 Battery
3_1, 3_2, --, 3_n battery cell
4 Battery voltage sensor
5 Battery cell selecting means
6 Capacitor
7 Capacitor voltage sensor
10 Arithmetic unit

[Translation done.]

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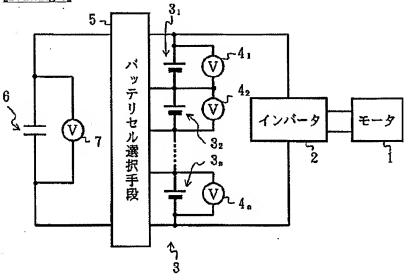
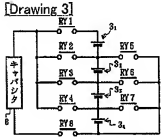
DRAWINGS

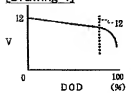
[Drawing 1]



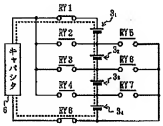
[Drawing 3]



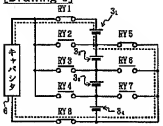
[Drawing 4]



[Drawing 5]



[Drawing 6]



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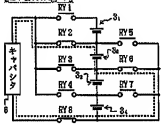
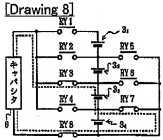
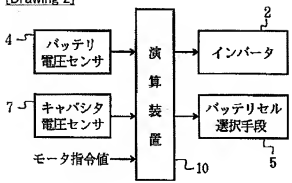


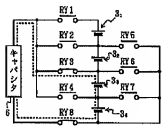
[Drawing 8]



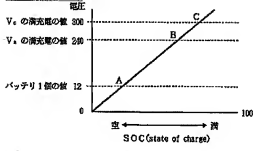
[Drawing 2]



[Drawing 9]



[Drawing 10]



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